

We claim:

1. A modular wide-range microwave communications unit comprising:
  - a precalibrated IF module having IF circuitry and an IF module memory operable for storing calibration values for the IF circuitry;
  - 5 at least one precalibrated RF module having RF circuitry and an RF module memory operable for storing RF calibration values for the RF circuitry.
2. The communications unit of claim 1, wherein the precalibrated RF module is an RF transmit module comprising an RF transmit circuitry and an RF transmit module memory operable for storing RF transmit calibration values for the RF transmit circuitry.
3. The communications unit of claim 1, wherein the precalibrated RF module is an RF receive module comprising an RF receive circuitry and an RF receive module memory operable for storing RF receive calibration values for the RF receive circuitry.
4. The communications unit of claim 1, wherein the precalibrated IF module further comprises IF transmit circuitry comprising plural IF transmit attenuators, IF receive circuitry comprising plural IF receive attenuators, an IF module memory, and a processor and instructions, the processor being operably configured to execute the instructions during operation of the communications unit, being operably coupled to the IF

module memory and RF module memory, the instructions comprising transmit instructions for controlling the IF transmit circuitry based on IF transmit calibration values stored in the IF module memory and controlling the IF receive circuitry based on IF receive calibration values stored in the 5 IF module memory.

5. The communications unit of claim 1, further comprising a radio processing unit which comprises the precalibrated IF module and precalibrated RF module, and a signal processing unit having a modem, the 10 signal processing unit operably coupled to the radio processing unit.

6. A microwave communications system, comprising plural communications units of claim 5, wherein plural radio processing units are operably coupled via wireless communications links to other radio 15 processing units, and plural signal processing units are operably coupled via a wireline network.

7. A modular wide-range microwave communications unit comprising plural precalibrated modules, each having a module memory operable for 20 storing calibration values for at least one of the group of transmit IF circuitry, transmit RF circuitry, receive IF circuitry, and receive RF circuitry.

8. The communications unit of claim 7, wherein a first precalibrated

module comprises an RF transmit module comprising RF transmit circuitry and an RF transmit module memory operable for storing RF transmit calibration values for the RF transmit circuitry.

5 9. The precalibrated RF module of claim 8, wherein the RF transmit circuitry comprises an attenuator, an IF detector and an RF detector, and the RF transmit module memory is operable for storing calibration values for the attenuator and IF and RF detectors.

10 10. The communications unit of claim 7, wherein one of the plural precalibrated modules is an RF receive module comprising an RF receive circuitry and an RF receive module memory operable for storing RF receive calibration values for the RF receive circuitry.

15 11. The RF receive module of claim 10, wherein the RF receive circuitry comprises an attenuator and the RF receive module memory is operable for storing calibration values for the attenuator.

12. The unit of claim 7, wherein one of the plural precalibrated modules is  
20 an IF module comprising IF transmit circuitry and IF receive circuitry, an IF module memory, and a processor and instructions, the processor being operably configured to execute the instructions and be operably coupled to each module memory, the instructions comprising transmit instructions for controlling the IF transmit circuitry and receive instruction for controlling

the IF receive circuitry based on IF transmit calibration values and If receive calibration values stored in the IF module memory.

13. The communications unit of claim 12, wherein the plural precalibrated  
5 modules further comprise an RF transmit module and an RF receive  
module, the RF transmit module comprising RF transmit circuitry  
including an attenuator, an IF detector and an RF detector, and an RF  
transmit module memory operable for storing RF transmit calibration  
values for the RF transmit circuitry, and the RF receive module comprising  
10 RF receive circuitry including a first receive attenuator and an RF receive  
module memory operable for storing RF receive calibration values for the  
first receive attenuator.

14. The communications unit of claim 13, wherein the IF transmit circuitry  
15 comprises a first digital attenuator coupled to a first analog attenuator, a  
first mixer coupled to the first analog attenuator, a second analog  
attenuator coupled to the first mixer, a second digital attenuator coupled to  
the second analog attenuator, and a transmit IF AGC coupled between the  
first digital and first analog attenuators, and wherein the instructions are  
20 operable for controlling attenuation by the attenuators of the IF transmit  
circuitry and RF transmit circuitry based on the IF and RF transmit  
calibration values.

15. The communications unit of claim 13, wherein the IF receive circuitry

comprises a receive RSSI detector operably coupled to plural receive attenuators, the plural receive attenuators operably coupled to a second mixer, the second mixer operably coupled to a further attenuator, and the further attenuator coupled to a receive AGC detector, and wherein the 5 instructions are operable for controlling attenuation by the attenuators of the IF receive circuitry and RF receive circuitry based on the IF and RF receive calibration values.

16. The communications unit of claim 12, further comprising a radio 10 processing unit which comprises the precalibrated IF module and precalibrated RF module, and a signal processing unit having a modem, the signal processing unit operably coupled to the radio processing unit.

17. A microwave communications system, comprising plural 15 communications units of claim 16, wherein plural radio processing units are operably coupled via wireless communications links to other radio processing units, and plural signal processing units are operably coupled via a wireline network.

20 18. A method of microwave communications using a wide-range communications unit, comprising:  
receiving control signals at a processor of the communications unit from a signal processing unit, the control signals containing first information including a modulation and frequency value;

retrieving stored calibration values from at least one of plural memories, the calibration values including attenuation values to be used during operation of the communications unit; and

the processor controlling at least one of the group of transmit 5 circuitry and receive circuitry, respectively, based on the calibration values and the control signals to attenuate a signal being transmitted or received, respectively, at the modulation and frequency value.

19. The method of claim 18, wherein the transmit circuitry comprises a 10 precalibrated IF module comprising an IF memory having IF calibration values and precalibrated RF transmit module comprising an RF transmit module memory having RF calibration values, further comprising controlling attenuators from the IF module and an attenuator and a detector in the RF transmit module together in a closed loop to achieve a 15 desired dynamic response, based on stored calibration values in the IF memory and RF transmit module memory.

20. The method of claim 19, wherein the detector of the RF transmit module comprises an RF detector, wherein the step of controlling further 20 comprises first determining target exact, min and max values for the RF detector based on an interpolation of stored calibration tables in the IF memory and RF transmit module memory for a measured temperature and selected frequency, modulation, and capacity, and multiplying the target min and max values by a correction factor.

21. The method of claim 20, further comprising comparing a measured detector value to the corrected target min and max values, and (i) when the measured detector value is outside the target min and max values,  
5 adjusting the attenuators one at a time in steps until the measured detector value is within the target min and max values, and (ii) when the measured detector value is within the target min and max values and an easing mechanism is enabled, incrementing the attenuators one at a time to drive the measured detector value toward the target exact value.

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22. The method of claim 18, wherein the receive circuitry comprises a precalibrated IF module comprising an IF memory having IF calibration values and precalibrated RF receive module comprising an RF receive module memory having RF calibration values, further comprising  
15 controlling attenuators from the IF module and an attenuator in the RF receive module together in a closed loop to achieve a desired dynamic response, based on stored calibration values in the IF memory and RF receive module memory.

20 23. The method of claim 22, further comprising determining target IF AGC values based on an interpolation of stored calibration tables in the IF memory and RF receive module memory for a measured temperature and selected frequency, modulation and capacity, and multiplying the target IF AGC values by a capacity/modulation correction factor to obtain a corrected

target value.

24. The method of claim 23, further comprising comparing a measured IF AGC value with the corrected target value, and incrementing the 5 attenuators in the IF module and the attenuator in the RF receive module one at a time to adjust the measured detector value toward the target exact value.

25. A method of operating a wide-range microwave communications unit, 10 comprising controlling attenuators from an IF module and an attenuator in an RF module together in a closed loop to achieve a desired dynamic response, based on stored calibration values in an IF module memory and an RF module memory.

15 26. A method of transmitting microwave signals using a wide-range transmitter, comprising:

receiving control signals at a processor of the transmitter from a signal processing unit, the control signals containing first information including a modulation and frequency value;

20 retrieving stored calibration values from an IF memory and an RF memory, the calibration values including attenuation values to be used during operation of the transmitter; and

the processor controlling IF circuitry and RF circuitry based on the calibration values and the control signals to attenuate a signal being

transmitted at the modulation and frequency value.

27. The method of claim 26, wherein the RF memory is an EEPROM in an RF module having stored RF calibration values regarding a detector and  
5 attenuator in the transmit RF circuitry, the step of retrieving comprising retrieving the stored RF calibration values, and the step of controlling further comprising controlling the IF circuitry and RF circuitry based on the calibration values and the control signals to attenuate a signal being upconverted for transmission at the modulation and frequency value.

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28. A method of receiving microwave signals using a wide-range receiver, comprising:

receiving control signals at a processor of the receiver from a signal processing unit, the control signals containing first information including a  
15 modulation and frequency value;  
retrieving stored calibration values from an IF memory and an RF memory, the calibration values including attenuation values to be used during operation of the receiver; and  
the processor controlling IF circuitry and RF circuitry based on the  
20 calibration values and the control signals to attenuate a signal being received at the modulation and frequency value.

29. A precalibrated IF module operable in a modular wide-range microwave transceiver, the IF module comprising:

transmit IF circuitry and receive IF circuitry, and an IF module memory for storing IF calibration values for transmit and receive IF circuitry;

a processor and instructions, the processor being operably configured

5 to execute the instructions and coupled to the IF module memory, and a RF transmit module memory and RF receive module memory, the instructions comprising:

transmit instructions for controlling the transmit IF circuitry and circuitry of the RF transmit module based on the IF calibration values and

10 RF transmit calibration values, and receive instructions for controlling the receive IF circuitry and circuitry of the RF receive module based on the IF calibration values and RF receive calibration values.

30. A precalibrated RF module operable in a modular wide-range microwave transceiver, the RF module comprising one of the group of:

a precalibrated RF (radio frequency) transmit module having an RF transmit module memory for storing RF transmit calibration values for circuitry of the RF transmit module, wherein the RF transmit module is operable together with a precalibrated transmit IF module having transmit

15 IF circuitry, an transmit IF module memory for storing transmit IF calibration values for the transmit IF circuitry, and a transmit processor and instructions, the processor being operably configured to execute the instructions when coupled to the transmit IF module memory and RF transmit module memory, the instructions comprising transmit instructions

for controlling the transmit IF circuitry and circuitry of the RF transmit module based on the transmit IF calibration values and RF transmit calibration values; and

- a precalibrated RF receive module having an RF receive module
  - 5 memory for storing RF receive calibration values for circuitry of the RF receive module, wherein the RF receive module is operable together with a precalibrated receive IF module having receive IF circuitry, an receive IF module memory for storing receive IF calibration values for the receive IF circuitry, and a receive processor and instructions, the processor being
    - 10 operably configured to execute the instructions when coupled to the receive IF module memory and RF receive module memory, the instructions comprising receive instructions for controlling the receive IF circuitry and circuitry of the RF receive module based on the receive IF calibration values and RF receive calibration values.

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- 31. A modular wide-range microwave receiver comprising:
  - the precalibrated RF transmit module of claim 30;
  - the precalibrated RF receive module of claim 30; and
  - a precalibrated IF module comprising the precalibrated transmit IF module and precalibrated RF module, wherein an IF module memory forms both the transmit and receive IF module memories, and an IF module processor forms both the transmit and receive processors.